Chapter 2

Hardware Component Overview

This chapter provides an overview of the router's hardware components:

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Chassis

The router chassis is a rigid sheet metal structure that houses all the other router hardware components (see Figure 1, Figure 2, and Figure 3). The chassis is 5.25 in. (13.3 cm) high, 17.4 in. (44.2 cm) wide, and 24 in. (60.9 cm) deep. The chassis installs into standard 19-in. equipment racks or telco center-mounted racks. Up to 14 routers can be installed into one standard, 78-in.-high rack.

The chassis includes the following components:

Two electrostatic discharge points (banana plug receptacles), one front and one rear

Two metal ears, usable either for front mounting or center mounting

Figure 1: Front View of the M5 Router

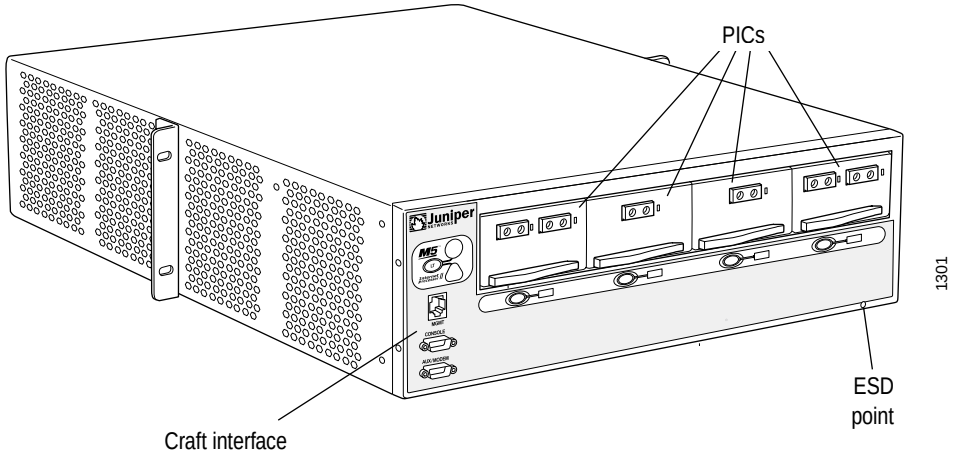


Figure 2: Front View of the M10 Router

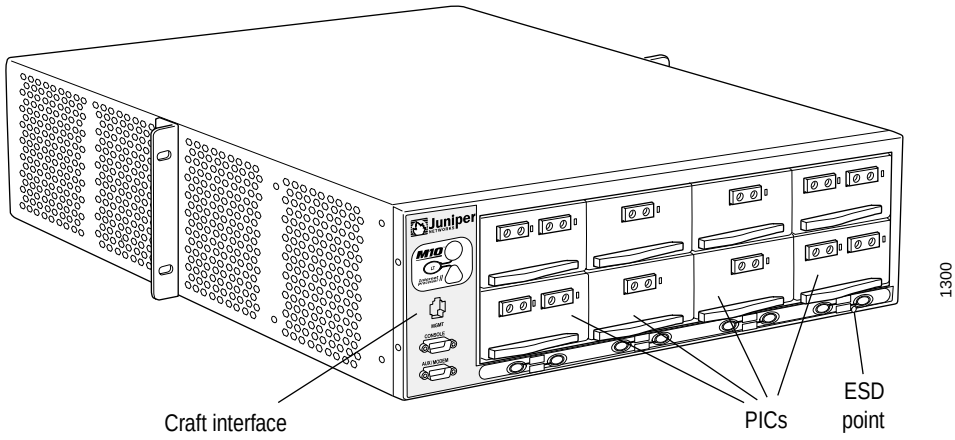
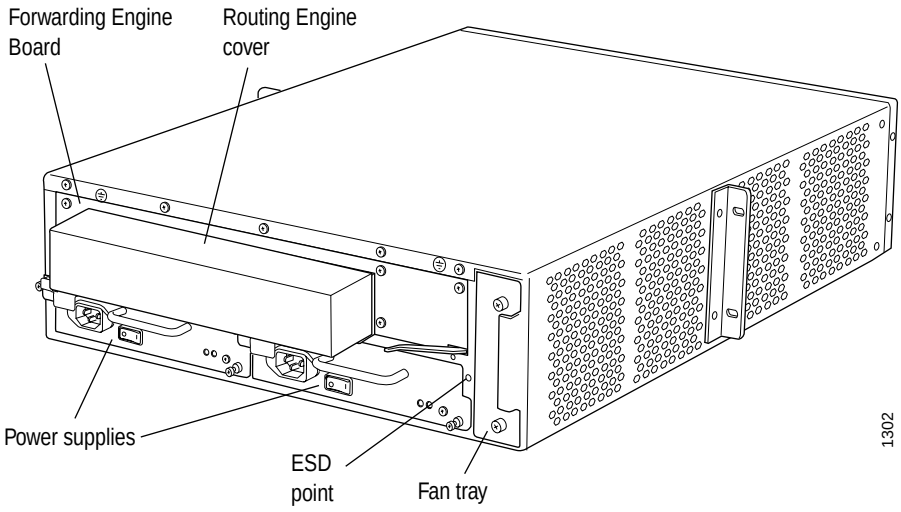


Figure 3: Rear View of the Router

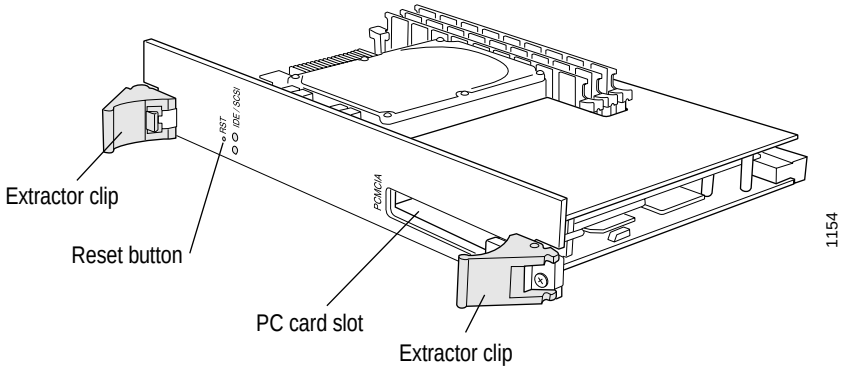


Routing Engine

The Routing Engine consists of an Intel-based PCI platform running JUNOS Internet software (see Figure 4). The Routing Engine maintains the routing tables used by the router and controls the routing protocol processes, as well as software processes that control the router's interfaces, some of the chassis components, system management, and user access to the router. For more information about the Routing Engine, see "Routing Engine" on page 31.

The Routing Engine is located in the upper rear of the router chassis. It is field-replaceable, but is not hot-removable or hot-pluggable. You must power down the router before removing or replacing it.

Figure 4: Routing Engine



Routing Engine Components

Each Routing Engine (shown in Figure 4) is a two-board system with the following components:

CPU—Runs JUNOS Internet software to maintain the router's routing tables and routing protocols. It has a Pentium-class processor.

SDRAM—Provides storage for the routing and forwarding tables and for other Routing Engine processes.

Compact flash disk—Provides primary storage. It can accommodate two software images, two configuration files, and microcode. This disk is fixed and inaccessible from outside the router.

Hard disk—Provides secondary storage for log files, memory dumps, and rebooting the system if the flash disk fails.

PC card slot—Accepts a removable PC card, which stores software images for system upgrades.

Interfaces for out-of-band management access—Provide information about Routing Engine status to devices (console, laptop, or terminal server) that can be attached to access ports located on the craft interface.

EEPROM—Stores the serial number of the Routing Engine.

LED—Indicates disk activity for the internal IDE interface. It does not necessarily indicate routing-related activity.

The LEDs that report Routing Engine status are located on the craft interface rather than the Routing Engine faceplate.

Reset button—Reboots the Routing Engine when pressed.

Extractor clips—Control the locking system that secures the Routing Engine in the chassis.

The appearance and position of electronic components or the PC card slot on your Routing Engine might differ from Figure 4 and other figures in this document. These differences do not affect Routing Engine functionality.

For specific information about components in your Routing Engine (for example, the capacity of the hard disk), issue the show chassis routing-engine command.

Packet Forwarding Engine

The Packet Forwarding Engine provides Layer 2 and Layer 3 packet switching, route lookups, and packet forwarding. The Packet Forwarding Engine uses application-specific integrated circuits (ASICs) to perform these functions. ASICs include the Distributed Buffer Manager, I/O Manager, Internet Processor II, and various media-specific controllers.

The Packet Forwarding Engine consists of the following components:

Midplane—The midplane occupies the center of the router chassis. The FEB, PICs, power supplies, and other major components connect to the midplane.

Forwarding Engine Board—The Forwarding Engine Board (FEB) installs into the midplane from the rear of the chassis.

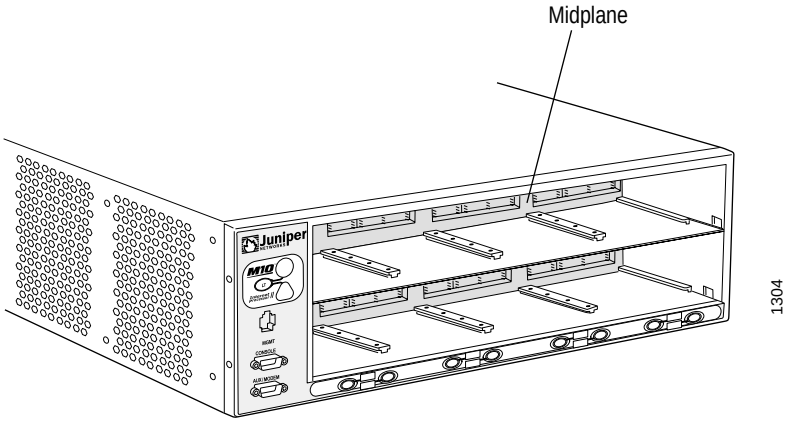
PICs—You can install up to four PICs into an M5 router and up to eight PICs into an M10 router. PICs provide support for various network media.

Midplane

The midplane forms the back of the PIC card cage (see Figure 5). The PICs and craft interface connect to the midplane on the front of the chassis, and the fan tray, power supplies, and FEB connect to the midplane from the rear of the chassis.

The midplane provides power distribution and signal connectivity. The router power supplies are connected to the midplane, which distributes power to the Routing Engine, the FEB, the PICs, and other system components.

Figure 5: Midplane



Forwarding Engine Board (FEB)

The Forwarding Engine Board (FEB) is located on the rear of the router above the power supplies (see Figure 6). It provides route lookup, filtering, and switching to the destination port. The FEB communicates with the Routing Engine using a dedicated 100-Mbps link that transfers routing table data from the Routing Engine to the forwarding table in the Internet Processor II ASIC. The link is also used to transfer routing link-state updates and other packets destined for the router from the FEB to the Routing Engine. The FEB provides the following functions:

Route lookups—The Internet Processor II ASIC on the FEB performs route lookups using the forwarding table stored in synchronous SRAM (SSRAM).

Management of shared memory—One Distributed Buffer Manager ASIC on the FEB uniformly allocates incoming data packets throughout the router's shared memory.

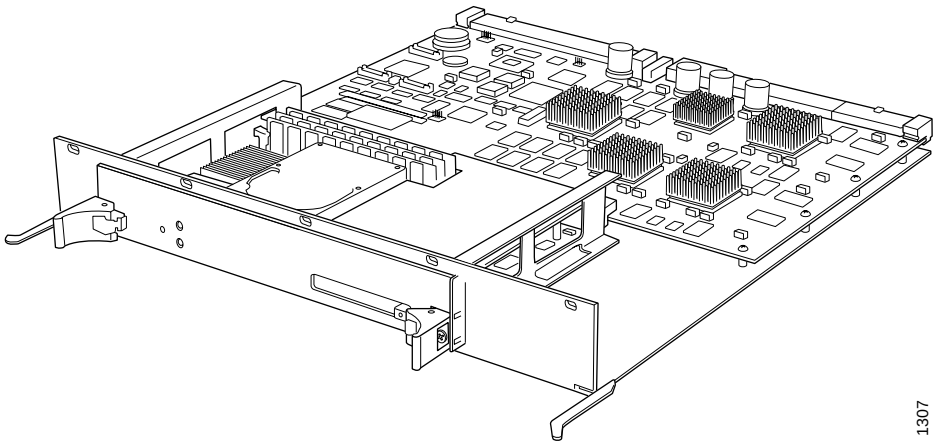
Transfer of outgoing data packets—A second Distributed Buffer Manager ASIC on the FEB passes data packets to the destination PIC when the data is ready to be transmitted.

Transfer of exception and control packets—The Internet Processor II ASIC passes exception packets to the microprocessor on the FEB, which processes almost all of them. The remainder are sent to the Routing Engine for further processing. Any errors originating in the Packet Forwarding Engine and detected by the FEB are sent to the Routing Engine using syslog messages.

The FEB is field-replaceable, but is not hot-removable or hot-pluggable. You must power down the router before removing or replacing the FEB.

Enhanced FEBs include an updated I/O Manager ASIC, with 2-MB SRAM. The updated I/O Manager ASIC is capable of enhanced quality of service.

Figure 6: Forwarding Engine Board



FEB Components

The FEB has the following major components:

- Processing components
  - 266-MHz CPU and supporting logic
  - Internet Processor II ASIC
  - Two Distributed Buffer Manager ASICs
  - One (on the M5 router) or two (on the M10 router) I/O Manager ASICs, each with 1-MB SRAM, or 2-MB SRAM on enhanced FEBs
  - 33-MHz PCI bus—Connects the system ASICs
- Storage components
  - Four banks of 2-MB SRAM for forwarding tables associated with the ASICs
  - 64-MB DRAM for the microkernel
  - I^2C EEPROM containing the serial number and revision level
  - Two 512-KB boot flash EPROMs (programmable on the board)
- System interfaces
  - 100-Mbps link for internal interface to the Routing Engine
  - 19.44-MHz reference clock for SONET PICs
  - I^2C controller to read the I^2C/EEPROMs in memory, the midplane, and the power supplies
- One PowerPC 603e processor
- Either 64-MB (on the M5 router) or 128-MB (on the M10 router) SDRAM—Used as shared memory by the Distributed Buffer Manager ASIC on the FEB

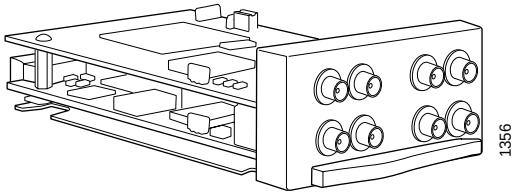
Physical Interface Cards (PICs)

You can install up to four PICs into an M5 router, and up to eight PICs into an M10 router. PICs provide the connection to various network media types.

PICs receive incoming packets from the network and transmit outgoing packets to the network. During this process, each PIC performs framing and line-speed signaling for its media type. Before transmitting outgoing data packets, each PIC encapsulates the packets it receives from the midplane. Each PIC is equipped with a media-specific ASIC that performs control functions tailored to the PIC's media type.

PICs are hot-removable and hot-insertable. Removing or inserting a PIC causes a brief interruption of forwarding performance. Each PIC has an ejector lever at the bottom of its faceplate that allows for easy removal from the router (see Figure 7).

Figure 7: DS-3 PIC for M5 and M10 Routers



PIC LEDs

Each PIC has status and port LEDs, located on the PIC faceplate. If the FEB detects a PIC failure, it powers off the failed PIC. For more information about PIC LEDs, see the *M5 and M10 Internet Routers PIC Guide*.

PIC Media Types

The router supports various PICs, including ATM, Channelized OC-12, DS-3, Fast Ethernet, Gigabit Ethernet, and SONET/SDH PICs. For more information about the PICs and the specific media types, see the *M5 and M10 Internet Routers PIC Guide*.

Craft Interface

The craft interface allows you to view alarm status at a glance and to perform some system control functions. The craft interface is located on the left front of the chassis, extending across the front below the PIC slots. The craft interface contains the following elements (see Figure 8):

Alarm LEDs and Lamp Test Button on page 15

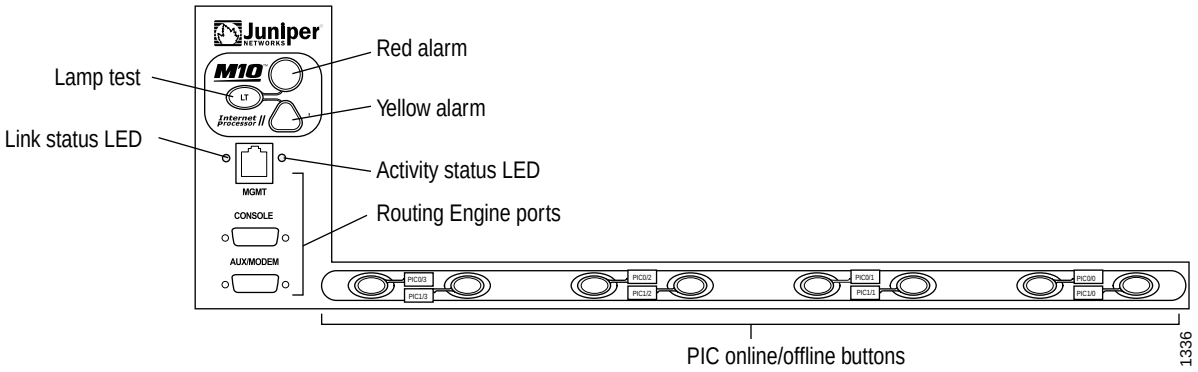
Routing Engine Ports on page 16

Link and Activity Status Lights on page 16

PIC Online/Offline Buttons on page 16

The power supply LEDs are located on the power supply faceplates, not on the craft interface panel. They are described in the section “Power Supplies” on page 16.

Figure 8: Craft Interface on an M10 Router



Alarm LEDs and Lamp Test Button

One large, circular red alarm LED and one large, triangular yellow alarm LED are located at the top of the craft interface panel (see Figure 8). The red alarm indicates a critical condition that can result in a system shutdown. The yellow alarm indicates a less severe condition that requires monitoring or maintenance. Both alarms can occur simultaneously.

To the left of the LEDs is the lamp test (LT) button. Pressing this button tests all the LEDs on the craft interface.

Table 3 describes the alarm LEDs and buttons.

Table 3: Alarm LEDs and Buttons

Label	Shape	Color	State	Description
Alarm LEDs (Both alarms can occur simultaneously.)				
Red alarm LED	○	Red	On steadily	System failure or power supply failure. The system is experiencing a hardware malfunction or some threshold is being exceeded.
Yellow alarm LED	△	Amber	On steadily	System warning such as maintenance alert or significant temperature increase.
LT	⬭	—	—	Test the LEDs on the craft interface.

Routing Engine Ports

The Routing Engine has three ports for connecting external management devices. You can use the JUNOS command-line interface (CLI) on these management devices to configure the router. The Routing Engine ports are located on the craft interface panel directly below the lamp test button (see Figure 8):

Ethernet management (MGMT) port—Used to connect the Routing Engine to a management LAN (or any other device that plugs into an Ethernet connection) for out-of-band management of the router system. The Ethernet port can be 10 or 100 Mbps and uses an autosensing RJ-45 connector.

Console (CONSOLE) port—Used to connect a system console to the Routing Engine with an RS-232 (DB-9) asynchronous serial cable.

Auxiliary (AUX/MODEM) port—Used to connect a laptop or modem to the Routing Engine with an RS-232 (DB-9) asynchronous serial cable.

Link and Activity Status Lights

The link and activity status lights are located adjacent to the MGMT port. The link status light is located to the left of the port, and the activity status light is located to the right of the port (see Figure 8). The link and activity status lights report the status of the external management connections. The link status light indicates whether the link has been established. It lights yellow for 10 Mbps connections and lights green for 100 Mbps connections. The activity status light indicates that data is being transferred; it lights green.

PIC Online/Offline Buttons

You use the PIC online/offline buttons to take a PIC offline when it needs to be removed, or bring it online when it is replaced. The oval buttons are located along the lower strip of the craft interface below the PICs, with rectangular labels. On the M10 router, the online/offline buttons labeled 0/0–0/3 control the upper row of PICS and the buttons labeled 1/0–1/3 control the lower row (see Figure 8).

Power Supplies

The router has two power supplies, which are located at the lower rear of the chassis (see Figure 3 on page 9). The power supplies are internally connected to the midplane, which distributes the different output voltages they produce throughout the system and its components.

The power supplies are fully redundant, and load-share during normal operation. A single power supply can provide full power (up to 434 W) for as long as the router is operational. Redundancy is necessary only if one of the power supplies fails.

Power supplies are hot-removable and hot-insertable, but you must turn off the power to the individual power supply before removing it from the chassis. Each power supply has a handle to facilitate removal from the chassis. When one power supply fails or is switched off, the other power supply immediately and automatically assumes the entire electrical load.

The router supports AC and DC power supplies (see Figure 9 and Figure 10, respectively). An enable control signal on the output connector ensures that the power supply is fully seated into the router midplane before the power supply can be turned on. The enable pin prevents a user-accessible energy hazard, so there is no interlocking mechanism. The enable pin disables the voltage at the output connector if the power supply is not turned off before removal.

> **Note** The router supports either AC or DC power supplies. It can be equipped with either two AC or two DC power supplies, but you cannot mix the two types.

Figure 9: AC Power Supply

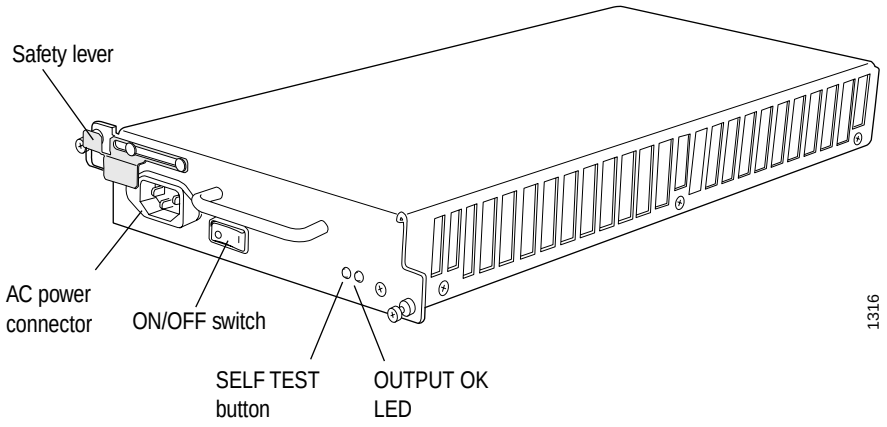
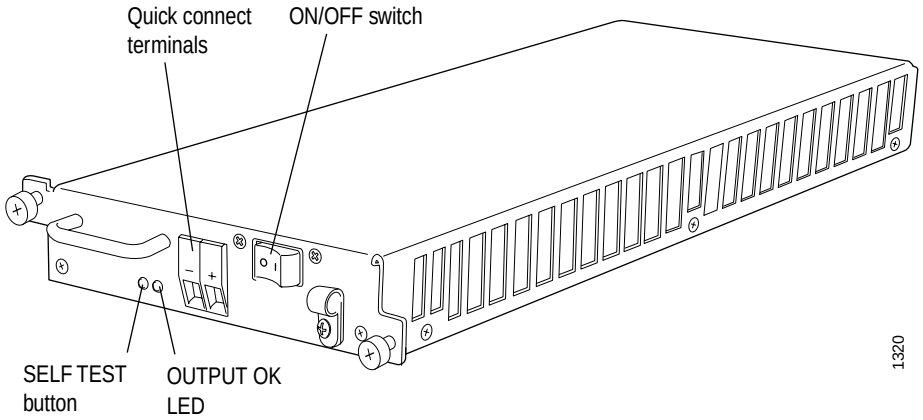


Figure 10: DC Power Supply



Power Supply LED and Self-Test Button

Table 4 describes the output LED and self-test button for both the AC and DC power supplies.

Table 4: Power Supply LED and Self-Test Button

Label	Color	State	Description
OUTPUT OK	Blue	On steadily	Power supply is functioning normally, input is occurring, outputs are within range, and the temperature is within range.
		Blinking	Indicates that the power supply has failed.
SELF-TEST	(button)	–	Initiates the power supply self-test.

Power Supply Electrical Specifications

Table 5 lists the AC power supply electrical specifications, and Table 6 lists the DC power supply electrical specifications.

Table 5: AC Power Supply Electrical Specifications

Description	Specification
Power supply	434 W maximum
Input voltage	100–264 VAC operating range
Input line frequency	47–63 Hz, autoranging
Input current rating	8.0 A @ 100 VAC, 4.0 A @ 240 VAC
Output voltage	+ 1.5 V, + 2.5 V, + 3.3 V, + 5.0 V, + 12 V, + 12V

Table 6: DC Power Supply Electrical Specifications

Description	Specification
Power supply	434 W maximum output
DC input voltage	–42.5 through –72 VDC operating range
Input DC current rating	13.5 A @ –48 VDC
Output voltage	+ 1.5 V, + 2.5 V, + 3.3 V, + 5.0 V, + 12 V, + 12V

The DC power supplies are marked –48 VDC, which is the nominal voltage associated with the battery circuit. You should associate any higher voltages with float voltages for the charging function.

Power Supply Cables

DC power supply cables are 12 AWG, single-strand-count wire cable, with two leads. The cables connect to the input and return quick connect terminals on each DC power supply.

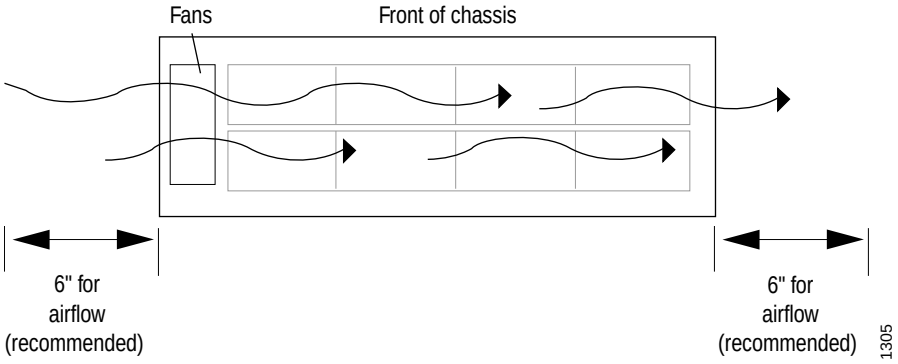
AC power supply cords are country-specific. The AC inlet is oriented to allow a standard right-angle power cord to exit to the right of the power supply. A power cord latching mechanism is provided for the use of straight power cords.

Cooling System

The router cooling system consists of a fan tray, located along the left side of the chassis, that provides side-to-side cooling (see Figure 11). The fan tray is a single unit containing four fans. It is hot-removable and hot-insertable. It connects directly to the router midplane.

The router should not be operated for more than 1 minute without a fan tray.

Figure 11: Air Flow through the Chassis



Cable Management System

The cable management system consists of two vertical pieces, each with a pair of metal hooks draped in a plastic shield, that attach to each side of the front of the chassis (see Figure 12). The cable management system is designed to maintain the proper bend radius for optical cables and to keep installed cables organized and securely in place. It evenly distributes the weight of the optical cables so that no individual cable is subjected to undue stress. It also eases cable installation by providing a place to store the cable and by keeping it from getting tangled.

Figure 12: Cable Management System